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ABSTRACT

A battery of immediate memory tests was given to eight mentally retarded Down's Syndrome Ss, eight controls matched on chronological age (CA), and eight controls matched on mental age (MA). All Ss were required to identify both receptively and expressively 24 items from the Peabody Picture Vocabulary Test. There was no significant difference between the verbal and nonverbal recognition scores for any of the groups during either auditory or visual input; the CA controls were able to recall significantly more words than the MA controls, who in turn recalled significantly more words than the Down's group; however, when the task was shifted to auditory recognition, the CA controls again scored significantly higher than the MA controls but there was no longer a significant difference between the MA controls and the Down's group. (SBH)

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The Nature of Short-Termed Memory Deficits in Retarded Mongoloid Subjects*

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INTRODUCTION

Short-term memory has been the subject of intense investigation since Ebbinghaus (1885) and Jacobs (1887) first measured the maximum number of nonsense syllables and digits individuals could recall without any errors. Since then, investigators have reported high correlations between a given subject's digit span and his mental age, I.Q., recognition vocabulary age, etc. (Thumpstone, 1917; Hunter, 1962; Jenson, 1965; McDade, 1974; Scott, 1968). The fact that mentally retarded subjects typically perform poorly on tests of short-term memory has led to numerous hypotheses concerning the reason(s) for their inability to learn at normal rates. The most frequently accepted explanation is the "Limited Buffer Theory" (Broadbent, 1958), which maintains that such subjects possess limitations in the amount of information which can be stored at a given time.

An alternative to the Limited Buffer Theory is the "Bottleneck Theory" (Tulving, 1968), which suggests that much of the information retained in short-term memory is lost during the recall process. Thus what is restricting one's memory capacity is not the actual storage of information so much as the retrieval of information from storage. Tulving (1968) has indicated that, in a free recall situation, ". . . the retrieval mechanism does not have access to all the relevant information available in storage." This is evidenced by the fact that our recognition

skills are quantitatively superior to our free-recall abilities (Postman and Rau, 1957; Slamacke, 1968; Tulving and Postman, 1966). According to Bower (1976, p.289) "The existence of a recall threshold implies that a subject frequently has information in storage that does not appear in recall."

The availability versus accessibility argument has received much attention during the past few years (Evans and Dallenbach, 1965; Kintsch, 1968, 1970; Kintsch and Morris, 1965; Murdock, 1968; Tulving and Pearlstone, 1966; Tulving and Thomson, 1971). Unfortunately, the majority of these investigations have utilized heterogenious samples of subjects whose sole criteria for grouping was either I.Q. or mental age. The literature suggests, however, that retardates of comparable mental ages and I.Q. levels, but of different etiologies, manifest a number of different behavioral characteristics. According to Adler (1976), "Genetic studies have demonstrated that certain chromosomal and metabolic abnormalities are related specific" deficits. Studies by Evans (1973) and by Pendleton (1973) report that mongoloids (specifically, Trisomy 21) possess significantly poorer auditory decoding and visual discrimination skills than do retardates with comparable mental ages and I.Q. levels, but of different etiologies. Bilvosky and Share (1965) similarly reported that mongoloids differ from other retardates in the ability to understand pictures. Since memory is viewed as being a neurobiochemical process, it would seem to be a valid assumption that a specific genetic disorder may cause a specific breakdown within the memory process, and that such a breakdown may be unique to that population.

The purpose of this investigation was to evaluate the performance of

subjects representing a specific type of retardation (i.e. Trismony 21, Down's Syndrome) on a battery of tests of immediate memory. It was hypothesized that if such subjects possessed retrieval limitations, then this deficit might become more apparent when their recall and recognition abilities were compared with those of normal subjects.

METHOD

Subjects. The 24 subjects selected for this investigation came from two general populations; normal subjects and retarded Down's subjects. Retarded Subjects were patients at the Birth Defects Evaluation Center at the University of Tennessee Memorial Research Center and Hospital. Each was genetically diagnosed as having Trisomy 21 Down's Syndrome and possessed a mental age between 3-6 and 5-6 (as determined by the Stanford-Binet Intelligence Test). The normal subjects chosen for this study comprised two control groups. Eight children currently attending the Knox County Schools were matched with the retarded group on the basis of chronological age (CA controls), while eight preschool children were selected due to their comparable mental ages (MA controls). All subjects passed a hearing screening (@25 dB ANSI, 1969; 250-6000 Hz).

STIMULI: The stimuli for this investigation were chosen from the beginning frames of the Peabody Picture Vocabulary Test. (Slide #1, please). Twenty-four pictures were selected to elicit one-syllable names of concrete objects. All subjects were required to identify these items both receptively and expressively. The words were arranged in unrelated sequences, varying in

length from two to eight items. In order to assure that these sequences were unrelated, the following controls were utlized:

1. No two words from the same semantic category appeared adjacent to each other (e.g. DOG never followed CAT or HORSE, and KNIFE never followed SPOON -- another utensil, or GUN -- another weapon.

2. No semantic category was represented more than twice within a given sequence (e.g. if CAR and TRUCK occured within a given sequence, then BOAT or BUS did not appear in that same sequence).

3. Word order within these sequences was also arranged to avoid any apparent meaningful combinations (e.g. DOG BALL; HORSE SHOE; CAT MOUSE; etc.).

Six separate lists meeting the above criteria were created. Each list was randomly selected during each testing session to be used for either recall or recognition testing.

PROCEDURES: Each subject received a battery of six tests designed to assess short-term memory skills (Slide #2, please). Subjects were tested individually in a quiet room while seated across a small table from the examiner. Test order was randomized. All stimuli were presented at the rate of one word per second. Visual presentation was achieved by flashing individual pictures of the stimuli before the subject. Auditory and visual recall testing followed the same procedures as the digit span subtest of the WISC (Wechsler, 1949). A subject's recall score was equal to the number of words contained in the longest sequence correctly repeated in its entirety. Recognition testing was also conducted with auditory and visual input. Recognition skills were assessed utilizing a three-alternative picture discrimination test. This testing was conducted both verbally (Where the subject could utilize the pictures as cues for retrieval) and non-verbally

(where only a pointing response was required). Thus, auditory non-verbal recognition was assessed in the following manner:

HORSE BALL SNAKE

(Slide #3, please) "Find one here." (Slide #4, please) ". . . and here" (Slide #5, please) " . . . and here." Visual non-verbal recognition was tested in this manner (may I have slides #6, 7, and 8 shown in succession, please). (Slide #9, please) "Find one here . . . " (slide #10, please) " . . . and here" (Slide #11, please) " . . . and here."

Each subject received a brief training period, during which time appropriate responses for each of the six tests were taught. An ability to recall and recognize two items(for both auditory and visual stimuli) was required before actual testing began. No subjects had to be eliminated due to failure to understand the tests or inability to perform at the minimum level. Ten randomly selected subjects were retested after a period of at least one week for reliability purposes. A Pearson Product-Moment Correlation was calculated from test-retest data. The reliability coefficient for this experiment was 0.89.

RESULTS

Statistical analysis of test data was conducted through the use of a three-factor mixed design with repeated measures on two factors (Winer, 1971). Subject Groups (Down's Subjects, MA Controls, CA Controls) was a between subjects variable, while Sensory Input (Auditory, Visual) and Test Type (Recall, Verbal Recognition, Non-verbal Recognition) were within subject variables. A significant three-way interaction precluded testing for main

effects (f=.62; df=.42; p .000) Post hoc comparisons for simple effects were conducted utilizing the Duncan's Multiple Range Test, with the .05 level chosen for significance (Slide #12, please).

The first major finding was there was no significant difference between the verbal and non-verbal recognition scores for any of the groups during either auditory or visual input. Thus, the elimination of the encoding task during non-verbal recognition did not appear to aid a subject's recognition abilities.

When auditory input was utilized, the CA Controls were able to recall significantly more words than the MA Controls, who in turn recalled significantly more words than the Down's Group. However, when the task was shifted to auditory recognition, note that this trend changes. While the CA Controls again score significantly higher than the MA Controls, there is no longer a significant difference between the MA Controls and the Down's Group. This suggests that the Down's and MA Groups store auditorily presented stimuli equally well, but that the MA Controls have greater access to this stored information during a free recall task. That is, the MA Controls apparently possess retrieval abilities which are superior to the Down's Subject's, although the storage skills of these two groups are about the same. On conclusion from this figure, then, is that the Down's subjects appear to have a retrieval deficit for auditorily presented unrelated words.

This slide also indicates, however, that although the Down's group performed significantly better on auditory recognition than auditory recall tasks, this increase is not sufficient to suggest that their storage skills are normal. If storage abilities were unimpaired, with retrieval being the only limiting factor, then we would expect the Down's group to score comparably

with their CA Controls on recognition testing. They not only failed to do this, but their recognition performance was also inferior to the recall scores of the CA Controls. Thus, it would appear that the Down's subjects are further restricted in their memory capacity by a storage deficit.

Now let us analysize these results when stimuli were presented visually. It can be seen from this slide that the Down's and MA groups have equally poor visual recall skills. However, it is also evident from this figure that the MA controls demonstrate a significant increase in visual memory skills when a recognition test is utlizied, while the Down's subjects fail to show any change in performance. This suggests that, while the MA controls are able to store visual stimuli, they have trouble retrieving this information without the aid of recognition cues. That is, they appear to possess limitations in the ability to retrieve visually presented material. It is important to remember that the recognition tasks are believed to bypass much of the retrieval process required during a memory task by limiting the search through storage to only three alternatives per stimulus item. Therefore, the fact that the Down's subjects were unable to score higher on visual recognition than during visual recall suggests that their ability to score visual images is significantly impaired (much more so than for auditorily presented material). Thus, the poor visual decoding and discrimination skills of mongoloids, reported by Bilvosky and Share (1965), Evans (1973), and Pendleton (1973), may be due to a storage deficit for visual stimuli.

In summary, the combination of storage and retrieval restrictions which is suggested in this investigation for the Down's subjects is not in agreement with many of the earlier studies reported in the literature, which have typically claimed an either/or dichotomy. One of the reasons for this lack of agreement

may be the uniqueness of the experimental population sampled. As previously indicated, few studies analyzing retardate behavior have attempted to control for both cause and level of retardation. The retardates utilized in those investigations are not representative of a homogenious population. It is possible, therefore, that the results from this experiment may not hold for other groups of retarded subjects, functioning on the same level, but of different etiologies.

Secondly, the poor storage skills of the Down's subjects and poor retrieval abilities of the MA controls for visually presented material brings up an important concept. If Sperling (1967) is correct in his hypothesis that all verbal material is stored auditorily (with visual stimuli being translated into an auditory mode), then examination of the different processes which would be required during the six memory tasks might provide some insight into the difficult which both the Down's and MA control groups appear to have. (Slide #13, please). From this table it can be seen, for example, that during a visual recognition task a subject, upon receiving the sensory input, would have to translate the stimuli into an auditory mode, store this auditory representation, and then translate it back into a visual image so as to perform on the picture discrimination task. Following this line of thinking, the Down's subjects would appear to have less facility in making the initial translation from a visual to an auditory mode. Thus, when presented with a visual recognition task, their performance does not improve over visual recall due to an impaired ability to translate the incoming signal. On auditory recognition testing, however, such a translation would not be required prior to storage, and the Down's subjects therefore are able to perform at a higher level. The MA controls, by virtue of their improved performance on visual recognition tasks, would appear to be

able to handle this visual-to-auditory mode translation. The difficulty which they encounter on visual recall tasks, then, must lie in some process occurring after the translated material is stored. Encoding the stored information into a verbal response does not seem to be the main problem, due to the ability of these subjects to perform such encoding tasks quite well during verbal recognition testing. Thus, the deficit in visual recall demonstrated by the MA controls is most likely located somewhere between the storage phase and the verbal encoding task. While there may be several processes which mediate storage and encoding, the most logical choice is that a limitation in the ability to retrieve information is responsible for the poor performance of the MA controls. Such a restriction would seem to be a part of normal development, although it appears to be less of a factor in later years (as evidenced by a failure of the CA controls to demonstrate this same trend).

References

Adler, S. The influence of genetic syndromes upon oral communication skills. Journal of Speech and Hearing Disorders, 41, 136-138, 1976.

Bilovsky, D. and Share, S. The I.T.P.A. and Down's Syndrome: an exploratory study. American Journal of Mental Deficiency, 70, 78-82, 1965.

Bower, G. A Multicomponent theory of memory trace. In K.W. Spence (Ed.) The Psychology of Learning and Motivation, vol. 1, 1967.

Broadbent, D. Perception and Communication. London: Pergamon Press, 1958.

Butterfield, E. and Wambald, C. On the theory of practice of improving short-term memory. American Journal of Mental Deficiency, 77, 654-669, 1973

Ebbinghaus, H. Uber das Gedachtnis: Untersuchungen zur Experimentelen Psychologie. Leipzig: Duncker and Humbolt, 1885.

Evans, R. and Dallenback, K. Single trial learning: a stochastic model for recall of individual words. American Journal of Psychology, 78, 545-556, 1965.

Evans, S. A study of selected aural-oral skills of children with various chromosomal abnormalities. Unpublished master's thesis, University of Tennessee, 1973.

Humpstone, J. Memory span and language proficiency. Journal of Learning Disabilities, 1, 644-648, 1968.

Hunter, I. Memory: Facts and Fallacies. Baltimore: Penguin Books, 1962.

Jacobs, J. Experiments on prehension. Mind, 12, 75-79, 1887.

Jensen,A. Rote learning in retarded adults and normal children. American Journal of Mental Deficiency, 69, 828-834, 1969.

Kellas, M., Ashcraft, M., and Johnson, N. Rehearsal processes in the short-term memory performance of mildly retarded adolescents. American Journal of Mental Deficiency, 77, 670-679, 1973.

Kintsch, W. Recognition and free recall of organized lists. Journal of Experimental Psychology, 78, 481-487, 1968.

Kintsch, W. Models for free recall and recognition. In D.A. Normal (Ed.) Models of Human Memory. New York: Academic Press, 1970.

Kintsch, W. and Morris, C. Application of a Markov model to free recall and recognition. Journal of Experimental Psychology, 69, 200-206, 1965.

McDade, H. An evaluation of methods for testing the auditory retention abilities of moderately retarded mongoloid subjects. Unpublished master's thesis, University of Tennessee, 1974.

Murdock, B. Modality effects in short-term memory: storage or retrieval? Journal of Experimental Psychology, 77, 79-86, 1968.

Pendleton, H. A study of selected oral language and visual perceptual skills of children with chromosomal abnormalities. Unpublished master's thesis, University of Tennessee, 1973.

Postman, L. and Rau, L. Retention as a function of the method of measurement. University of California Publications in Psychology, 8, 271-296, 1957.

Scott, K. Research and theory in short-term memory. In N. Ellis (Ed.) International Review of Research in Mental Retardation, New York: Academic Press, 1968.

Slamecka, N. An examination of trace storage in free recall. Journal of Experimental Psychology, 76, 504-513, 1968.

Sperling, G. A model for visual memory tasks. Journal of Human Factors Society, 5, 19-36, 1963.

Tulving, E. Theoretical issues in free recall. In T. Dixon & D. Horton (Eds.) Verbal Behavior and General Behavior Theory. Englewood Cliffs: Prentice-Hall, 1968.

Tulving, E. and Pearlstone, Z. Availability versus accessibility of information in memory for words. Journal of Verbal Learning and Verbal Behavior, 5, 381-391, 1966.

Tulving, E. and Thomson, D. Retrieval process in recognition memory. Journal of Experimental Psychology, 87, 116-124, 1971.

Wechsler, D. Wechsler Intelligence Scale for Children. New York, Psychological Corporation. 1949.

Winer, B. Statistical Principle in Experimental Design. New York: McGraw-Hill, 1971.

ALPHABETICAL LISTING OF TEST STIMULI

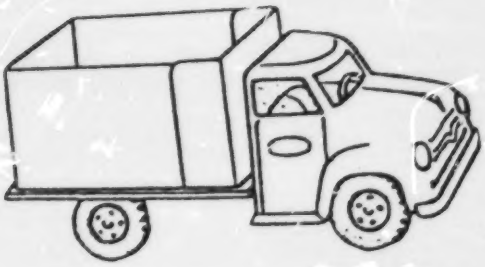
(SLIDE #1)

BALL
BEE
BOAT
BUS
CAR
CAT
CHAIR
CLOWN
CUP
DOG
DRUM
FISH
GIRL
GUN
HORSE
KITE
KNIFE
MOUSE
SHOE
SNAKE
SPOON
STOVE
TREE
TRUCK

SUMMARY OF THE SIX SHORT-TERM MEMORY TESTS UTILIZED: TYPE OF STIMULUS PRESENTATION AND THE RESPONSE REQUIRED OF THE SUBJECT

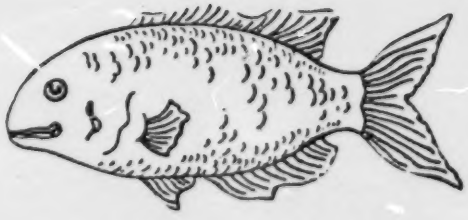
(SLIDE #2)

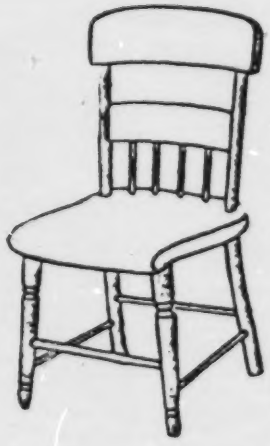
Test	Stimulus Presentation	Recognition Pictures Presented Following Stimulus Presentation	Subject's Response
Recall	Auditory	No	Verbal
Recall	Visual	No	Verbal
Verbal Recognition	Auditory	Yes	Verbal
Verbal Recognition	Visual	Yes	Verbal
Non-verbal Recognition	Auditory	Yes	Pointing
Non-verbal Recognition	Visual	Yes	Pointing



SLIDE #3

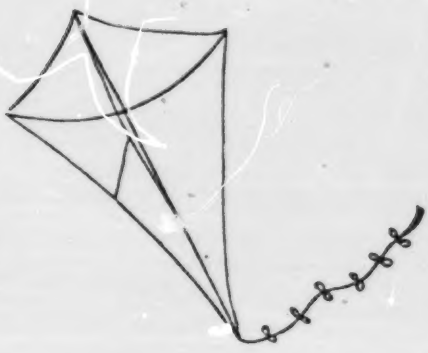
SLIDE #4





SLIDE #5

SLIDE #6



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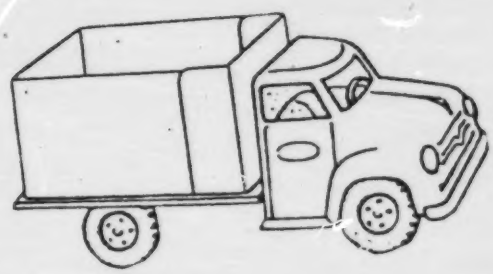

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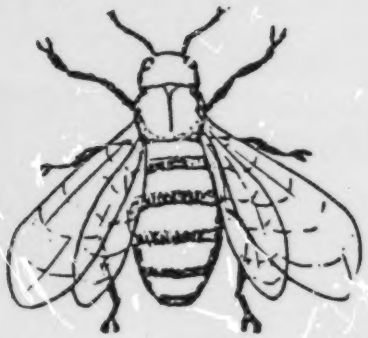

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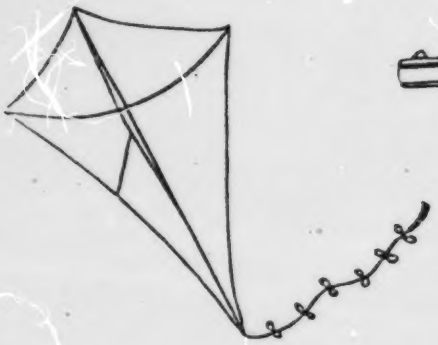
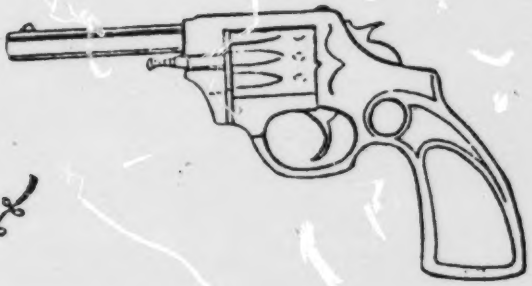
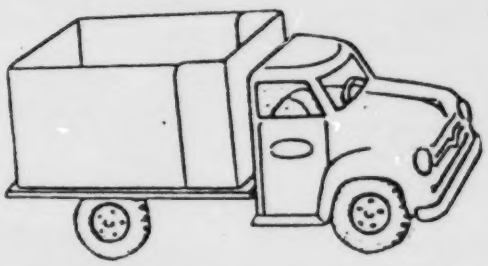


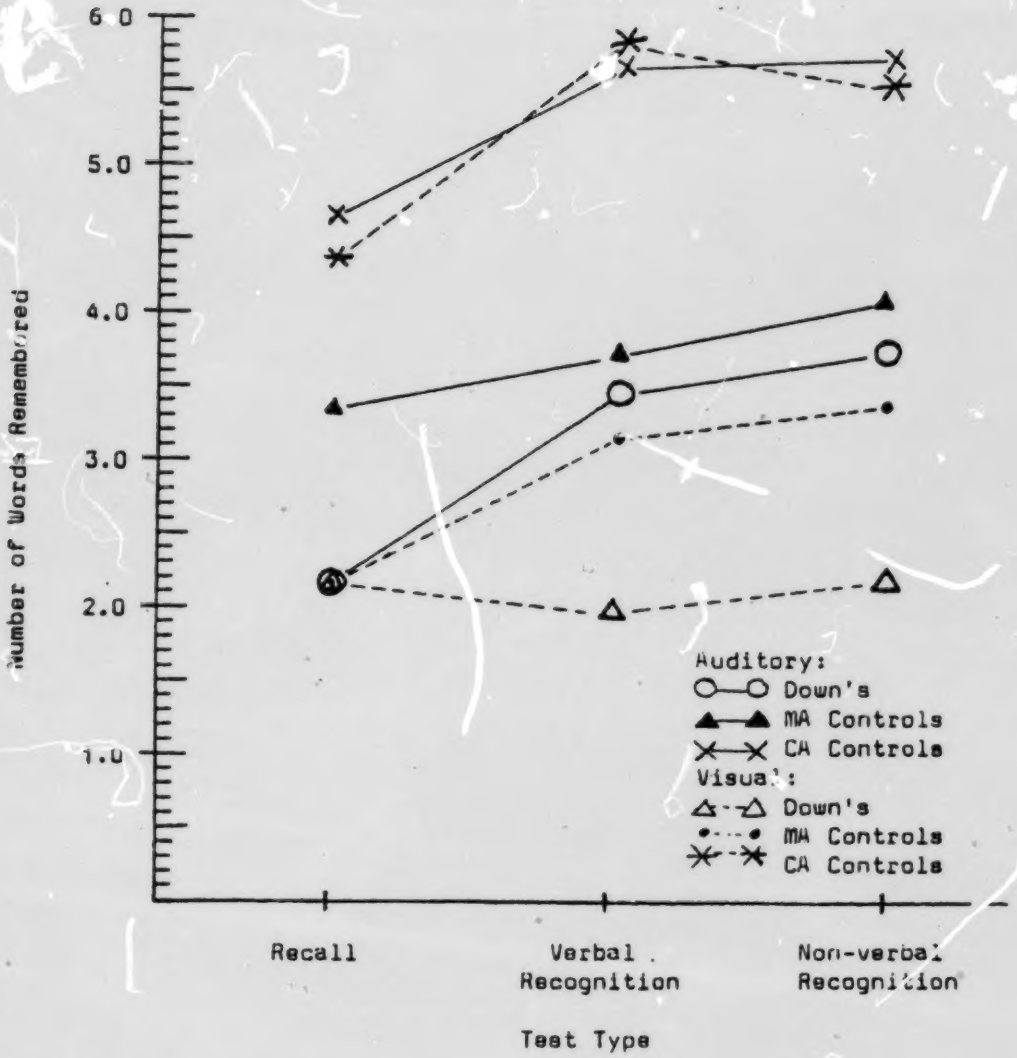


SLIDE #10



SLIDE #11

(SLIDE #12)



Mean scores for the recall, verbal and non-verbal recognition tests as a function of subject group and sensory input.

(SLIDE #13)

SUMMARY OF THE SIX SHORT-TERM MEMORY TESTS
AND THE SENSORY TRANSLATIONS REQUIRED
FOR EACH, AS PROPOSED BY SPERLING

Test	Sensory Input	Processes Required
Recall	AUDITORY	---------- → (store) ---------- → + encode
Recall	VISUAL	—(translate)→ AUDITORY (store) ---------- → + encode
Non-verbal Recognition	AUDITORY	---------- → (store) —(translate)→ VISUAL (discrim.)
Non-verbal Recognition	VISUAL	—(translate)→ AUDITORY (store) —(translate)→ VISUAL (discrim.)
Verbal Recognition	AUDITORY	---------- → (store) —(translate)→ VISUAL (discrim.) + encode
Verbal Recognition	VISUAL	—(translate)→ AUDITORY (store) —(translate)→ VISUAL (discrim.) + encode